

MASTER OF SCIENCE IN COMPUTER SCIENCE

IMPLEMENTATION OF DATA FLOW QUERY LANGUAGE (DFQL)

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A relational database management system (RDBMS) is a software product that structures data in accordance with the relational data model and permits data manipulation based on relational algebra. There are two widely-used query languages for the relational database management systems (RDBMSs). These are Structured Query Language (SQL) and Query By Example (QBE). Although these languages are powerful, they both have drawbacks concerning ease-of-use, especially in expressing universal quantification and specifying complex nested queries.

In order to eliminate these problems, Data Flow Query Language (DFQL) has been proposed. DFQL offers an easy-to-use graphical user interface to the relational model based on a data flow diagram, while maintaining all of the strengths of SQL and QBE.

The purpose of this thesis is to implement DFQL, allowing the users to login one or more relational database(s) through JDBC, view the structure of the connected databases graphically, and implement inquiries in SQL and DFQL to retrieve the data from the database(s).

DoD KEY TECHNOLOGY AREAS: Computing and Software, Human Systems Interface

KEYWORDS: Structure Query, SQL, QBE, Data Flow Query Language, DFQL, Java, JDBC, Database Structure

RECOGNITION OF SHIP TYPES FROM AN INFRARED IMAGE USING MOMENT INVARIANTS AND NEURAL NETWORKS

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Autonomous object recognition is an active area of interest for military and commercial applications: Given an input image from an infrared or range sensor, interesting objects can be found in those images and then classified. In this work, automatic target recognition of ship types in an infrared image is explored. The first phase segments the original infrared image in order to obtain the ship silhouette. The second phase calculates moment functions of those silhouettes that guarantee invariance with respect to translation, rotation and scale. The third phase applies those invariant features to a back-propagation neural network

and classifies the ship as one of the five types. The algorithm was implemented and experimentally validated using both simulated three-dimensional ship model images and real images derived from video of an AN/AAS-44V Forward Looking Infrared (FLIR) sensor.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Surface/Under Surface Vehicles - Ships and Watercraft

KEYWORDS: Automatic Target Recognition, Artificial Neural Network, Infrared Image Recognition, Moment Invariants

SEMANTIC INTEROPERABILITY IN AD HOC WIRELESS NETWORKS

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Ad hoc wireless networks are decentralized networks whose members join and leave the network in an asynchronous manner and for short periods of time. Each node participating in the network acts both as host and a router

Ad hoc networks in theory, support missions of the Armed Forces in situations in which the infrastructure for wire-bound networks is not dependable, it is impractical to build and maintain the infrastructure, or the missions requires that the nodes have a high-degree of mobility.

Ad hoc wireless networks require some level of semantic interoperability so that nodes in the network can "understand" each other. In this thesis, requirements for semantic interoperability in ad hoc wireless networks are discussed, and a case study is presented of how such requirements could be applied. It was realized during the study that semantic interoperability components and functions are developed mostly for wired networks, and not taking in consideration the wireless issues such as processing, power, and networking limitations. In this thesis, wireless user infrastructure, mobile middleware, and wireless application protocols as a solution to realize semantic interoperability in wireless ad hoc networks are discussed.

DoD KEY TECHNOLOGY AREAS: Command, Control and Communications, Computing and Software

KEYWORDS: Ad Hoc Networks, Routing Protocols, Semantic Interoperability, Wireless Networking

USER-CENTERED ITERATIVE DESIGN OF A COLLABORATIVE VIRTUAL ENVIRONMENT

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Most tasks that are desirable to train in a virtual environment are not tasks that we do alone, but rather are executed collaboratively with one or more team members. Yet little is known about how to construct virtual environment training systems that support collaborative behavior. The purpose of this thesis was to explore methodologies for developing collaborative virtual environments for training. The approach centered on analyzing task or training specific requirements for the simulation environment. User-centered design techniques were applied to analyze the cognitive processes of collaborative wayfinding to develop interface design guidelines. The results of our analysis were utilized to propose a general model of collaborative wayfinding. This model emphasizes team collaboration and interaction in problem solving and decision-

making. The model in the field, using cognitive task analysis methods to study land navigators. This study was intended to validate the use of user-centered design methodologies for the design of collaborative virtual environments. Our findings provide information useful to design, ranging from model enhancement to interface development. The cognitive aspects of collaborative human wayfinding and design for collaborative virtual environments have been explored. Further investigation of design paradigms should include cognitive task analysis and behavioral task analysis.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Human Systems Interface, Modeling and Simulation

KEYWORDS: Virtual Environments, Wayfinding, Collaboration, Land Navigation, Virtual Reality, User-Centered Design

**DESIGN AND IMPLEMENTATION OF WEB-BASED SUPPLY CENTER'S MATERIAL
REQUEST AND TRACKING (SMART) SYSTEM USING
JAVA AND JAVA SERVLETS**

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In order for decision makers to efficiently make accurate decisions, pertinent information must be accessed easily and quickly. Component-based architectures are suitable for creating today's three-tiered client-server systems. Experts in each particular field can develop each tier independently. The first tier can be built using HTML and web browsers. The middle tier can be implemented by using the existing server side programming technologies that enables dynamic web page creation. The third tier maintains the database management systems.

Java servlets and Java provide the programmers platform and operating system with independent, multi-threaded, object oriented, secure and mobile means to create dynamic content on the web. The Java Servlets Session Tracking API is a potential solution to the problems arising from the fact that HTTP is a "stateless" protocol.

The use of connection pools with database applications provides faster data access, and decreases the use of system resources. Connection pools also offer a solution to the limited number of connections open to a specific database at a given time.

This thesis explores the existing client-server architectures and server side programming technologies such as CGI, ASP and Java Servlets. The thesis also prescribes the design and implementation of a three-tier application using Java and Java servlets as the middle tier, and Java Database Connectivity to communicate with the database management systems.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Other (Database)

KEYWORDS: Software, Database, Structured Query Language (SQL), Common Gateway Interface (CGI), Active Server Pages (ASP), Java Database Connectivity (JDBC) Java Servlets, Java

ANALYSIS, DESIGN AND IMPLEMENTATION OF A WEB DATABASE WITH Oracle8i

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This thesis represents a model of web-database analysis, design and implementation. An electronic bulletin board for the Naval Postgraduate School is implemented for demonstration. The model includes Oracle8i DBMS as the database, Java (Java Server Pages, Java Script, Enterprise Java Beans, Java Servlets) as the

programming language. Apache HTTP Server v.1.3 / Tomcat v.1.2 is used as the Web server and JSP engine. Windows NT4.0 served as the OS environment. From the technical aspect, Database Management Systems, Web-Database Architectures, Server Extension Programs, Oracle8i, as well as several other software and hardware components are reviewed, and some are recommended.

DoD KEY TECHNOLOGY AREA: Other (Web-Database, Oracle8i)

KEYWORDS: Oracle DBMS, Oracle8i, Java Server Pages, Enterprise Java Beans, Web-Database, Apache/Tomcat1.2, Two-tiered Architecture, Multi-tiered Architecture

INTERCONNECTIVITY VIA A CONSOLIDATED TYPE HIERARCHY AND XML

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Building a software system that passes any message type between legacy Command, Control, Communications, Computer, Intelligence, Surveillance and Reconnaissance (C4ISR) systems is proposed. The software system presents significant cost savings to the Department of Defense (DoD) because it allows continued use of already purchased systems without changing the system itself.

In the midst of the information age, the DoD cannot get information to the warfighter. Heterogeneous legacy systems are still maintained and used, which send limited information via a set of common messages developed for a specific domain or branch of DoD. The ability to communicate with one message format does not meet our needs today, though these stovepipe C4ISR systems will provide vital information. By combining these systems, we will have a synergistic effect on our information operations because of the shared information.

Our translator will resolve date representational differences between the legacy systems using a model entitled the Common Type Hierarchy (CTH). The CTH stores the relationships between different data representations and captures what is needed to perform translations between the different representations. The platform neutral extensible Mark-up Language (XML) will be used as an enabling technology for the CTH model.

DoD KEY TECHNOLOGY AREAS: Command, Control, and Communications, Computing and Software

KEYWORDS: Interoperability, Interconnectivity, Legacy Systems, XML, Consolidated Type Hierarchy, Information Systems

AN ARCHITECTURE AND PROTOTYPE SYSTEM FOR AUTOMATICALLY PROCESSING NATURAL-LANGUAGE STATEMENTS OF POLICY

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Organizations are policy-driven entities. Policy bases can be very large and complex; these factors are compounded by the dynamic nature of policy evolution. Thus, comprehension of the ramifications of both policy modification and assurance of the consistency, completeness, and correctness of a policy base

necessarily requires some level of computer-based support.

A policy workbench is an integrated set of computer-based tools for developing, reasoning about, and maintaining policy. A workbench takes as input a computationally equivalent form of policy statements.

In this thesis, approaches for translating natural-language policy statements into their equivalent computational form with minimal user interaction are explored. The architecture of a natural-language input-processing tool (NLIPT) is presented, which was designed to augment a policy workbench. NLIPT components consist of an extractor, index-term generator, structural modeler, and logic modeler.

Experiments were with a prototype of the extractor. The extractor successfully parsed twenty-seven of a sample of ninety-nine of U.S. Department of Defense security policy statements. An additional twenty-one statements were correctly parsed based on the syntactic structure of the input.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Command, Control, and Communications, Human Systems Interface

KEYWORDS: Natural-language Processing, Policy, Security, Formal Methods

A SIMPLE SOFTWARE AGENTS FRAMEWORK FOR BUILDING DISTRIBUTED APPLICATIONS

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The development of distributed systems needs to consider multiple factors such as performance, scalability, resource sharing, and fault tolerance. This thesis proposes a simple agent-based framework to address these concerns when building distributed applications. Agents act as interfaces among processes that interact and cooperate in a distributed environment. These agents encapsulate the implementation details and make the network transparent to running processes. The proposed framework is built on JINI infrastructure. It uses Linda TupleSpace model, a shared network-accessible repository, for different processes to exchange information. Processes are loosely coupled. They discover and linkup with one another by using services residing on JINI infrastructure. Under this proposed model, the correspondent language wrappers such as Java, Ada, C++, C and Visual Basic support multiple programming languages. Information exchange among processes is not restricted to data only. Executable components, leveraging on Java code's portability features, can be sent over a heterogeneous environment and executed remotely.

This framework can further address several important issues on formal specifications of the communication layer, such as partial failure, synchronization, coordination and heterogeneity, by offering properties in our design for operation timeout, and information and service leasing. This framework is to be used in the Distributed Computer Aided Prototyping System (DCAPS) to provide the inter-process communication layer. It simplifies the tasks of designing, binding and analyzing multiple processes of real-time, distributed prototype systems.

The provided interface library shields developers from working on the underlying dynamic and complex network environment. It supports a wide variety of programming languages and operating platforms. Important issues under distributed environment, such as partial failure, synchronization and coordination, have been taken into consideration.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Other (Distributed System, Interoperability)

KEYWORDS: ActiveX, Agent, Distributed Systems, Framework, Interoperability, JavaSpace, JINI, Software, TupleSpace, Wrapper

QUALITY OF SERVICE FOR IP-BASED NETWORKS

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In recent decades, the networking community has been looking for strategies to converge over a single common network infrastructure carrying voice, video and data. The pervasive and ubiquitous packet-based IP network provides the most convenient platform for the desirable convergence, where resources can be managed in an efficient and dynamic manner.

The gradual convergence into the IP infrastructure introduces multimedia-rich and interactive applications that are bandwidth-intensive and delay-bound, while more sophisticated data applications are deployed that place new demands onto IP networks. The IP-based network is evolving to satisfy the requirements of traffic differentiation and reliable service. Quality of Service (QoS) mechanisms are introduced to meet the traffic expectations and enhance the basic service model of the network in many subtle ways.

This thesis provides a comprehensive examination of QoS mechanisms and protocols that have surfaced to optimize the utilization of network resources, to provide differentiated treatment of traffic and enforce the appropriate policies. The study proposes a balanced approach of bandwidth increase and integration of robust QoS techniques into existing IP network infrastructure to arrive at a convergent, multiservice and scalable telecommunications network. Findings from this thesis can be incorporated into the design and implementation of an integrated network within a large organization that will deliver accurate services and defined level of performances.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Command, Control, and Communications

KEYWORDS: Networking, Convergence, Quality of Service, IP Multiservice Network, Policy-based Network, Traffic Management

REALISTIC TRAFFIC GENERATION CAPABILITY FOR SAAM TESTBED

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Traffic modeling is an important component of the design of any communication network. This is even more crucial for emerging networks, which are expected to operate in high speed and high bandwidth environments. As the design of a network depends to a great extent on the types of traffic it is expected to carry, it is essential to characterize the traffic that a network is expected to carry. This is where traffic models are very important. They can be used to produce artificial traffic input that exhibits essential characteristics of real network loads.

This thesis describes a design and implementation of a general-purpose traffic generator for a testbed of the Server and Agent Based Active Network Management (SAAM) architecture. The traffic generator is easy to use and implements the four most important traffic models (Constant Bit Rate (CBR), Poisson, Packet-Train, and Self-Similar). With this traffic generator, the SAAM project now has the capability of simulating and testing the system components in more accurate and more realistic environments.

DoD KEY TECHNOLOGY AREA: Computing and Software

KEYWORDS: Traffic Model, CBR, Poisson, Packet-Train, Self-Similar, Next Generation Internet, Networks